

Patent claims:10/511557
DT04 Rec'd PCT/PTO 15 OCT 2004

ART 34 AMDT

1. A process for joining at least two substrates, in particular having electrical, semiconducting, mechanical and/or optical components, comprising the steps of

providing a first substrate,

producing a joining element in the form of a frame on a first surface of the first substrate, a binary system of materials, a glass or a vitreous material being used as material for the frame, and the binary system of materials, the glass or the vitreous material being applied by evaporation coating,

providing a second substrate, and

joining the first and second substrates by means of the joining element.

2. The process as claimed in claim 1, in which the joining element is deposited on the first surface of the first substrate and is joined to the first substrate while it is being deposited.

3. The process as claimed in one of the preceding claims, in which the joining element is applied to the first surface of the first substrate by evaporation coating.

4. The process as claimed in one of the preceding claims, in which a frame is applied by evaporation coating as the joining element.

5. The process as claimed in one of the preceding claims, in which one or more supporting elements are produced inside the joining element on the first surface of the first substrate.

6. The process as claimed in one of the preceding claims, in which a plurality of nested frames are applied by evaporation

coating as the joining element.

ART 34 AMDT

7. The process as claimed in one of the preceding claims, in which the step of producing the joining element comprises
5 deposition of a binary material system by evaporation coating.

8. The process as claimed in one of the preceding claims, in which a glass layer is applied by evaporation coating and structured through a mask to form the joining element.

10

9. The process as claimed in one of the preceding claims, in which the joining element is structured by means of the lift-off technique.

15

10. The process as claimed in one of the preceding claims, in which the joining element and the second substrate are adhesively joined, soldered or bonded.

20

11. The process as claimed in one of the preceding claims, in which the joining element and the second substrate are joined by means of anodic bonding, fusion bonding, sol-gel bonding or low-temperature bonding.

25

12. The process as claimed in one of the preceding claims, in which the first and second substrates comprise a first and second wafer, respectively, a multiplicity of laterally adjacent joining elements are produced on the first surface of the first wafer, and after the first and second wafers have been joined to form a wafer assembly, the wafer assembly is
30 diced into individual chips.

35

13. The process as claimed in one of the preceding claims, in which a cavity is formed between the first and second substrates and inside the frame.

ART 34 AMDT

14. The process as claimed in one of the preceding claims, in which interconnects are arranged on the first surface of the first substrate, and the joining element is applied to the first surface by evaporation coating in such a manner that the interconnects are at least partially covered.

15. The process as claimed in one of the preceding claims, in which the interconnects extend laterally or vertically through the joining element.

16. The process as claimed in one of the preceding claims, in which the joining element is planarized after it has been produced on the first surface of the first substrate.

17. The process as claimed in one of the preceding claims, in which alignment elements are produced on the first or a second surface of the first substrate, the second surface being on the opposite side from the first surface.

18. The process as claimed in one of the preceding claims, in which a multiplicity of substrates are jointed to form a stack.

19. A composite element, in particular having electrical, electronic, semiconducting, mechanical and/or optical components, and in particular produced using the process as claimed in one of the preceding claims, comprising a first substrate, a joining element on a first surface of the first substrate, the joining element being a frame made from a binary system of materials, a glass or a vitreous material, and the joining element being applied to the first surface of the first substrate by evaporation coating, a second substrate, the first and second substrates being joined by means of the joining element.

ART 34 AMDT.

20. The composite element as claimed in claim 19, in which the joining element is deposited on the first surface of the first substrate and is joined to the first substrate.

5

21. The composite element as claimed in one of the preceding claims, in which one or more supporting elements are arranged on the first surface of the first substrate within the joining element.

10

22. The composite element as claimed in one of the preceding claims, which comprises a plurality of nested frames as the joining element.

15

23. The composite element as claimed in one of the preceding claims, in which the joining element comprises a structured glass layer.

20

24. The composite element as claimed in one of the preceding claims, in which the joining element is structured and the structuring is a structuring produced by means of a lift-off technique.

25

25. The composite element as claimed in one of the preceding claims, in which the joining element and the second substrate are adhesively joined, soldered or bonded to one another.

30

26. The composite element as claimed in one of the preceding claims, in which the joining element and the second substrate are joined and the joining is a join produced by means of anodic bonding, fusion bonding, sol-gel bonding or low-temperature bonding.

35

27. The joining element as claimed in one of the preceding claims, in which the first and second substrates comprise a first and second wafer, respectively, a multiplicity of

ART 34 AMDT

laterally adjacent joining elements are arranged on the first surface of the first wafer, and the joining elements are joined to a surface of the second substrate.

5 28. The composite element as claimed in one of the preceding claims, in which a cavity is formed between the first and second substrates and inside the frame.

10 29. The composite element as claimed in claim 31, in which the cavity is hermetically sealed.

15 30. The composite element as claimed in one of the preceding claims, in which interconnects which are at least partially covered by the joining element are arranged on the first surface of the first substrate.

20 31. The composite element as claimed in one of the preceding claims, in which the interconnects extend laterally or vertically through the joining element.

32. The composite element as claimed in one of the preceding claims, in which at least one surface of the joining element is planarized.

25 33. The composite element as claimed in one of the preceding claims, in which alignment elements are arranged on the first or a second surface of the first substrate, the second surface being on the opposite side from the first surface.

30 34. An intermediate product for producing the composite element as claimed in one of the preceding claims, in particular having electrical, electronic, semiconducting, mechanical and/or optical components, comprising
35 a first substrate,
a joining element on a first surface of the first substrate,

the joining element being a frame formed from a binary system of materials, glass or a vitreous material, and the joining element being applied to the first surface of the first substrate by evaporation coating, and

5 the joining element being designed in such a manner that the first substrate can be joined to a second substrate by means of the joining element.

35. A stacked composite element, comprising a multiplicity of
10 composite elements as claimed in one of the preceding claims which are joined to one another.

36. The use of a structure in the form of a frame formed from a binary system of materials, a glass or a vitreous material
15 for joining two substrates which is applied by evaporation coating as a spacer between two substrates or as an alignment element, in particular in accordance with a process and/or for producing a composite element as claimed in one of the preceding claims.

20

37. A process for joining substrates having electrical or optical components, in particular as set forth in one of the preceding claims, in which

a first and a second substrate are provided,
25 in a first step, a frame is applied to at least one surface of the first substrate, glass being used as material for the frame and the glass being applied by evaporation coating, and

in a second, subsequent step, a surface of the second
30 substrate is joined or bonded to the frame, a cavity being formed between the first and second substrates and inside the frame.

38. A composite element, in particular having electrical or
35 optical components on a substrate, in particular as set forth

in one of the preceding claims, comprising

a first and a second substrate,

at least one frame which has been applied to a surface of the first substrate, the frame comprising a structured glass layer which has been applied by evaporation coating, and

a joining region in which a surface of the frame is joined or bonded to a surface of the second substrate,

a cavity being formed between the first and second substrates inside the frame.

10

39. A process for joining at least two substrates, in particular having electrical, semiconducting, mechanical and/or optical components, comprising the steps of providing a first substrate,

15 producing a joining element on a first surface of the first substrate,

providing a second substrate, and

joining the first and second substrates by means of the joining element,

20 a plurality of nested frames being produced as the joining element.

40. A composite element, in particular having electrical, electronic, semiconducting, mechanical and/or optical

25 components, in particular produced by the process as set forth in one of the preceding claims, comprising a first substrate,

a joining element on a first surface of the first substrate, a second substrate,

30 the first and second substrates being joined by means of the joining element, and

a plurality of nested frames being provided as the joining element.